[redacted]

[redacted] 25X1

November 1, 1968

CONFIDENTIAL

25X1 [redacted]
Post Office Box 6788
Fort Davis Station
Washington, D. C. 20020

25X1 Attention: [redacted]
Subject:
Anamorphic Eyepieces for the High Power Stereoviewer

Gentlemen:

We have enclosed three copies of a paper on the design of the anamorphic eyepieces. We hereby request your permission to present this paper at the Spring meeting of the Optical Society of America. In order to accomplish this we must submit an abstract early in December, therefore we are requesting clearance prior to December 1.

Thank you for your cooperation in this matter.

Very truly yours,

[redacted] 25X1

New Program Planning
Photogrammetric and Military Systems

ASNoto:mm
Encs.

Group 1
Excluded from automatic downgrading and declassification

CONFIDENTIAL

Declass Review by NGA.

A Prism Variable Anamorphic Eyepiece System for a Microscope

25X1 [redacted]

A variable anamorphic capability had to be provided for use in the [redacted] 25X1

25X1 [redacted] Zoom "70" Stereoscope. To be practically feasible the system had to be easily and quickly usable thus it was to be compact, require essentially no microscope modification and be simply and quickly interchangeable with standard eyepieces. Optically the system was to provide 1X to 2.2X continuously variable anamorphism in any desired direction with an erect image and no loss of apparent field. Diffraction limited image quality had to be maintained under all possible combinations of Zoom "70" and anamorphic magnification. It was desirable that the system be insensitive to normal mechanical tolerances and minor alignment errors.

After some study a prism type anamorphic zoom system was chosen because it seemed potentially able to solve the mechanical requirements of the system. It could be designed somewhat shorter and much smaller in diameter than comparable cylindrical lens anamorphic zooms and provided insensitivity to minor manufacturing and alignment errors. Of major importance, anamorphic and non-anamorphic image surfaces are always coplaner in a prism anamorphic system regardless of component tolerances and their relative positions.

The optical system of the instrument consists of an identical pair of field and collimating lenses with the prism anamorphic components placed between them. (See Figure 1) A Pechan prism is placed between each collimator and field lens to perform a unique combination of functions described below. This configuration was necessary since the entire system must be above the erecting prism cluster of the Zoom "70" and be contained within half of the 55mm minimum I.P.D. of the instrument.

The optical design of spherical components of the system followed entirely standard procedures. The combination of two field and collimating lenses provided a symmetric one to one relay system with collimated light between them. The Pechan prisms were placed in the system between the field and collimating lenses at 90° to one another to fold the optical path and to erect the image. By using this method the focal lengths of the collimator and field lenses are increased to reduce both field angles and field curvature in the system while system length is maintained at a minimum. The increase of axial speed in the collimated light space reserved for the zoom system is of little consequence to prism zoom design. All that is required is a somewhat larger scaling of the system to accept the larger beam diameter. A slight deviation from symmetry was required (for mechanical reasons) in the Pechan prism sizes to provide sufficient working distance for standard eyepieces on one end, while maintaining an absolute minimum of length. This assymetry as well as the aberration contributed by the long glass paths in the prisms were compensated by the design of the collimator doublets and the choice of different glasses for the pechans. Nominally the pupil of the system is imaged between the two collimator lenses in the middle of the prism zoom system. A standard eyepiece is used to view the final image.

The design of the prism zoom system is the most unique part of the system. In this design it was necessary to obtain unusually good correction of aberrations over a substantial field angle for this type system. In addition pupil parameters had to be controlled to prevent eyepiece vignetting and maintain eye relief with a given microscope. Essentially both entrance and exit pupils of the system were predetermined. The design is further complicated by the presence of the non-anamorphosed plane of the image which eventually acts as a standard of comparison and the non-anamorphosed exit pupil which must be always in coincidence with the anamorphosed pupil. These requirements and the absolute premium of available space make it possible to obtain only a rough prototype using the procedures normally applied to complete such a design. Four quasi-achromatic prisms were used in the design to provide the required 2.2X to 1X afocal zoom range with adequate correction. Only anamorphic magnifications greater than unity were permitted because the field of view is determined by the microscope and must always fill the field stop of the eyepiece. Since prism zoom systems are basically symmetric they usually work around unit power. The 2.2X to 1X range therefore is essentially equivalent in difficulty to requiring a 4.84 to 1 zoom range. In fact, except for physical stops, the final system will perform at magnifications of from .45X to 2.2X with no loss in image quality or pupil control. The four prisms also permitted a straight through system and adequate freedom to control lateral and longitudinal pupil shifts.

After the system was roughed out a raytrace program was developed to trace entire tangential and sagittal fans from any object point through the entire system. This permitted detailed examination of exact chromatic aberrations and distortion, study of exit pupil characteristics, and determination of apertures of the prism system itself. Although the prism system in collimated light does not contribute any other aberrations of its own the program was also necessary to ascertain the effects of the prism systems variable magnification on the aberrations already present in the system. Then by redesign of the collimating system they could be altered to provide suitable final values. Graphical methods were also used extensively to correct the pupil characteristics of the system, establish required thicknesses, and determine prism pivot points to obtain the smallest possible system.

Distortion correction required the prisms to be grouped into pairs, each prism of a pair canceling the distortion of the other as was expected. It was found however, that with the predetermined field angles the necessary amount of color correction throughout the zoom range could not be obtained simply by using achromatic wedges. Using the programs it was possible to obtain adequate correction by altering the individual color correction of each pair of achromatic prisms to obtain a dynamic balance of the exact chromatic aberrations throughout the zoom range. Both prisms of a pair were maintained identical in achromatism but the pairs were balanced against each other throughout the zoom range. By using this method the required similarity between prism pairs to obtain pupil control was still obtainable as was the required similarity between prisms of a pair needed to control distortion.

Several prototypes of the final system have been built and have performed in every respect according to predictions. Image quality with the equipped microscopes has proved to be equivalent to that of the unequipped instrument. The device has proven insensitive to the moderate tolerances imposed on its manufacture and extremely simple to align and adjust. The only necessary adjustments have been those required to establish the ends of the zoom range. This was not unexpected since the effect of manufacturing tolerances are primarily to alter pupil parameters. Here tolerances effect measured in thousandths of an inch are imperceptible. If they occurred in image parameters as with cylinder zoom systems they would be disastrous. Those which do effect imagery, such as collimation errors and prism angle tolerances are easily adjusted out. Prism surface accuracy tolerances which produce a non-compensatible collimation error in the prism zoom have proven unimportant since over a diopter of error is necessary to produce a detectable image degradation. Lateral pupil shift during anamorphic zooming has been reduced to immeasurable values and longitudinal pupil disparity is never greater than 0.5mm. The entire prism zoom system is less than 20mm long and 8mm in diameter. The entire package increases the microscope length less than 4 inches, weighs about a pound and interchanges with standard eyepieces in seconds.

With this success a similar system was designed for use with the [redacted] 25X1
High Power Stereo Viewer system. Essentially the same zoom system was used. This was possible since the zoom system is independently well corrected. Here a pupil plane was accessible at the upper relay of the system and negative collimating optics could be used. Thus the Pechan prisms were not needed to erect the image and field flattening was obtained by balancing the power of the decollimating optics with the negative collimator. This system has also been built and has proven very successful. It increases the microscope eyepoint only 20mm and is so small that a substantial portion of it is inserted into the tube of the microscope itself. The optical train is approximately one inch long.

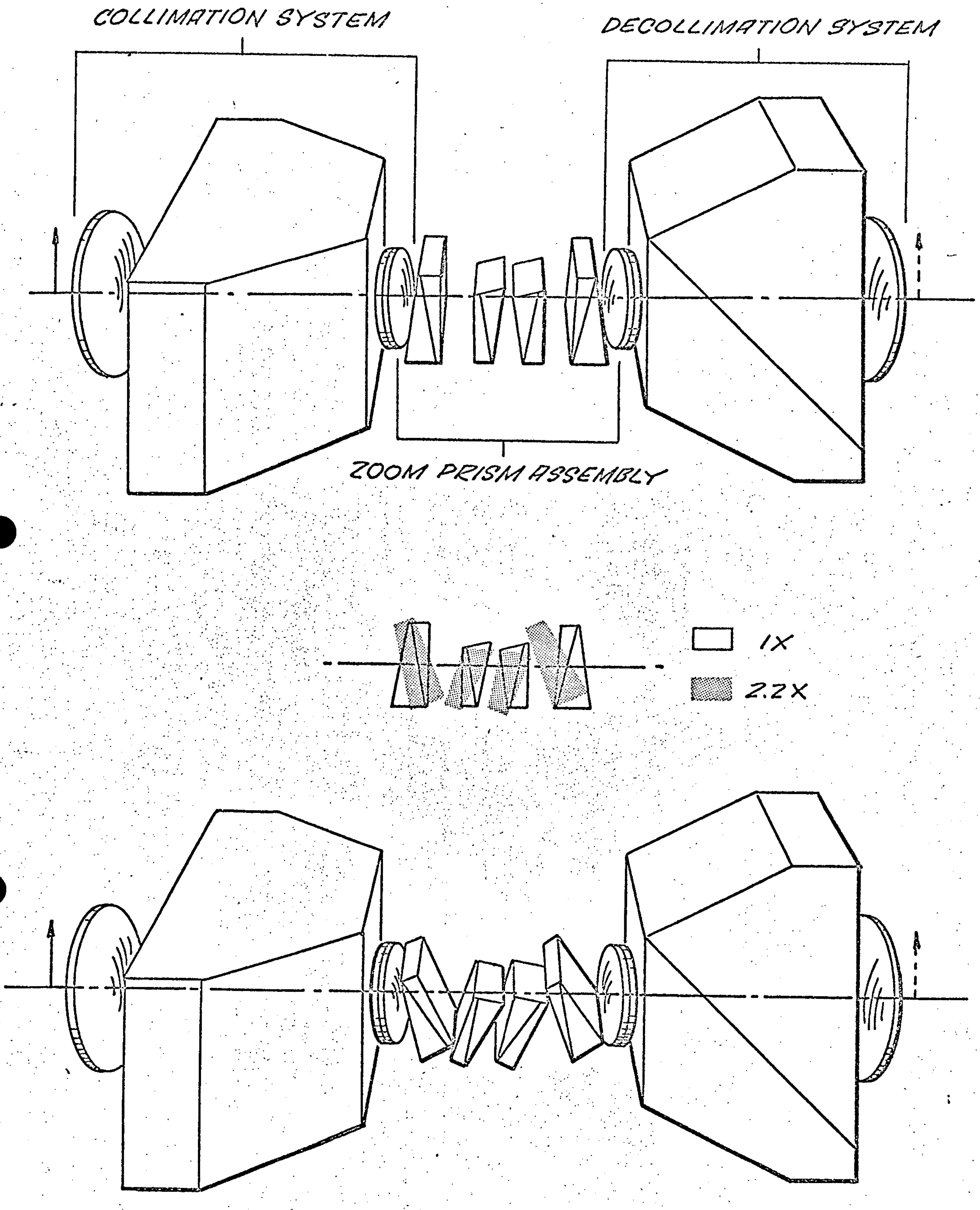

FIGURE 1. ZOOM ANAMORPHIC EYEPIECE

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99845

SECRET
(When Filled In)

SPEED LETTER	REPLY REQUESTED ✓ YES NO	DATE 12-12-67 LETTER NO.
TO : NPIC/PSDS ATTN: [redacted] 25X1	FROM: OSS/PD/OL	

25X1 [redacted]

Prism Variable Anamorphic Optical System.
Contractor has filed patent appl. copy attached.
Should application be classified?

RDL

SIGNATURE

REPLY	DATE 15 December 1967

1. The attached application is not classified. Incidently, the Contractor apparently violated Article 17 (9-106.1) of the General Provision when they filed the application without first obtaining written approval of the Contracting Officer.

2. Information is requested regarding the propriety of this application relative to the Government's use. Can NPIC use the information disclosed in the application in other developments in view of the fact that such applications are classified within the Patent Office? Can the information be freely disseminated to other Contractors for their sole use of developing and fabricating equipment for Government use within the rights granted by the January 1965 Revision of General Provisions?

[redacted] 25X1

RESPONDER'S FILE

FORM 5-61 1831 SECRET

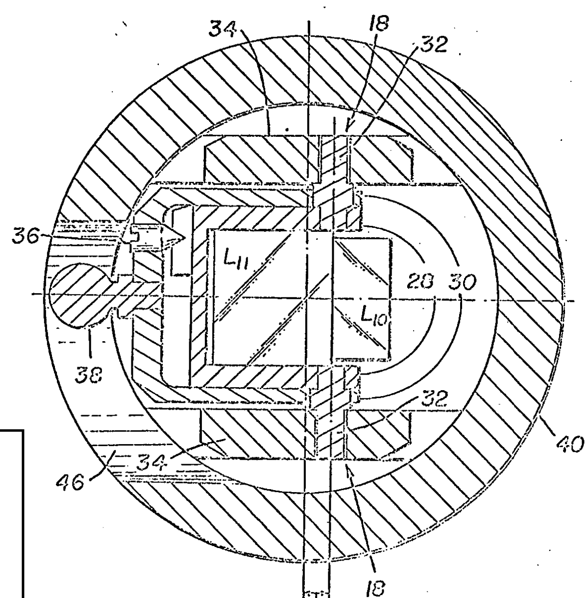

FIG. 5

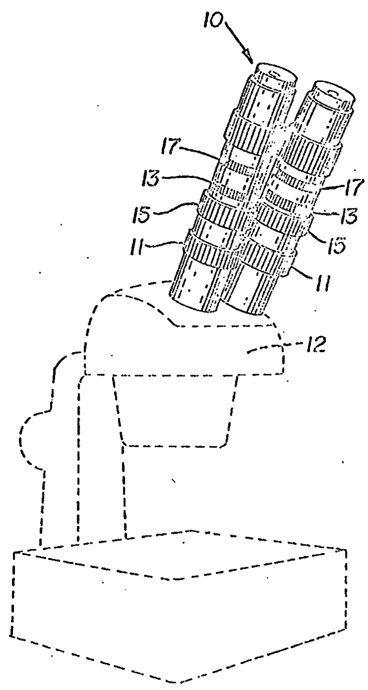

FIG. 1

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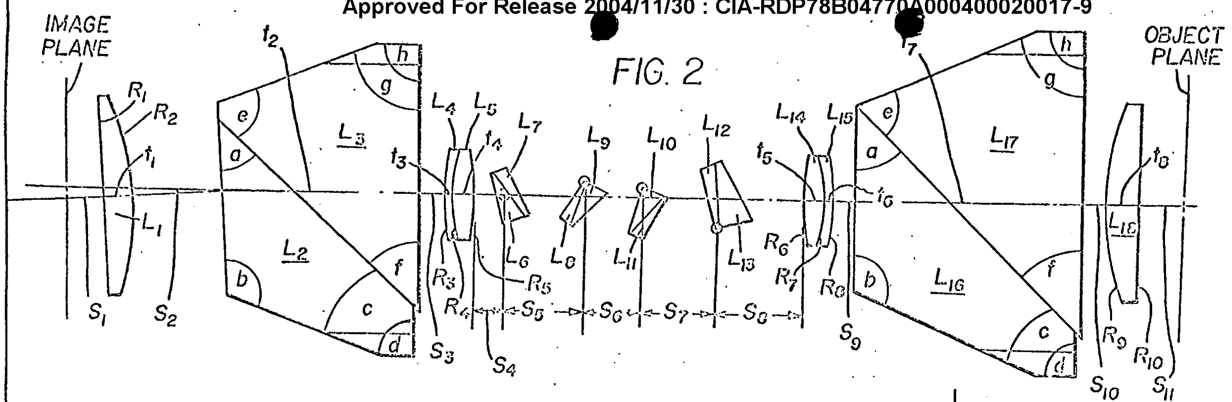
FILED SEPT. 25, 1967

25X1

FIG. 2



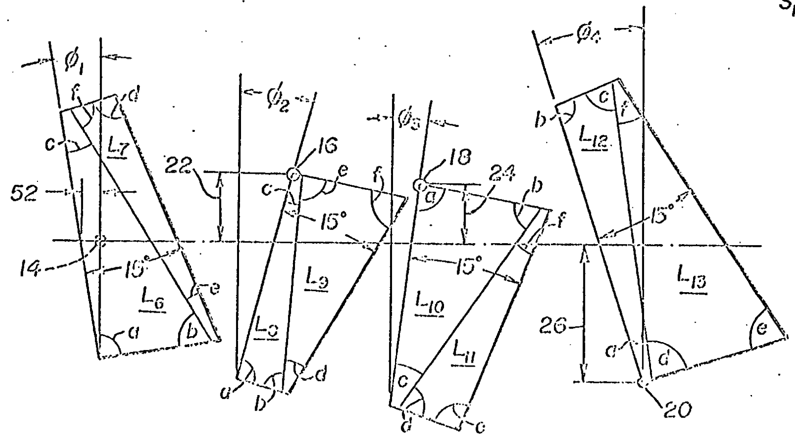


FIG. 3

25X1

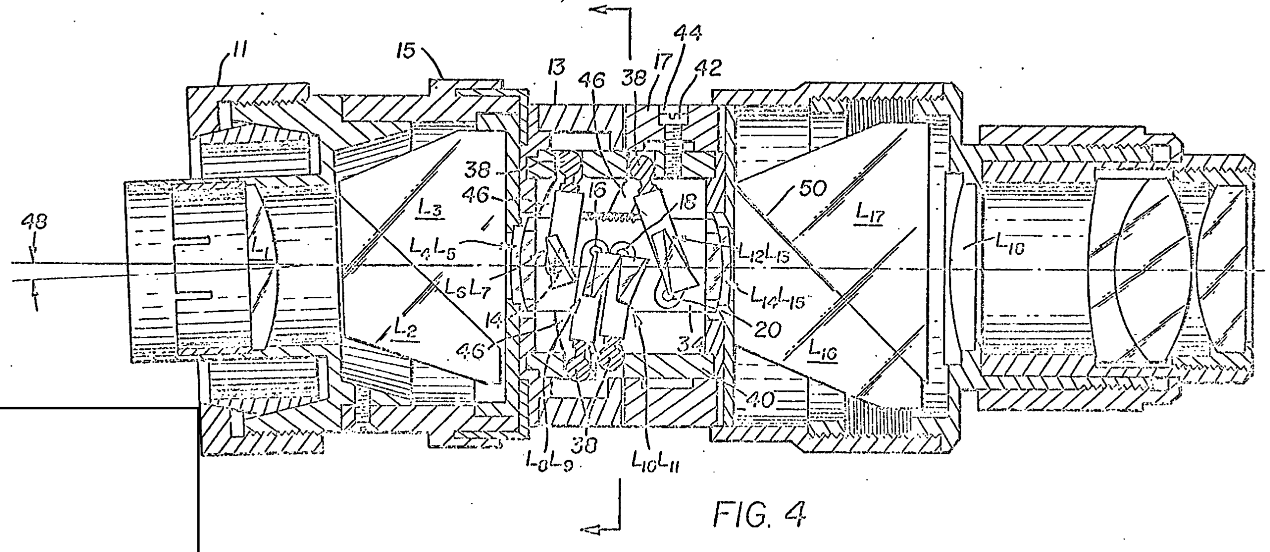


FIG. 4

25X1 [redacted]

U.S.SERIAL NO. 670,221

FILED SEPTEMBER 25, 1967

Application of

[redacted] 25X1

For United States Patent On

PRISM VARIABLE ANAMORPHIC OPTICAL SYSTEM

Prism Variable Anamorphic Optical System

ABSTRACT OF THE DISCLOSURE

A continuously variable anamorphic system designed to be adapted to microscopes, said system being variable between the ranges of 1x to 2.2x. The basic optical system consists of a pair of field lenses, a pair of collimating lenses, four refracting compound prisms, and a pair of image inverting prisms all combined to produce the prism variable anamorphic optical system.

CROSS REFERENCES TO RELATED APPLICATIONS

None.

BACKGROUND OF THE INVENTION

This invention relates generally to an anamorphic optical system and more particularly relates to a continuously variable prism anamorphic optical system designed for use in a microscope or the like.

Heretofore, anamorphic optical systems have been generally utilized with cinematographic equipment used to project wide angle motion pictures on a motion picture screen. For example, Patent No. 2,995,066, issued to Georges Duffresse on April 8, 1961, discloses such a use of an anamorphic optical system. This system, utilizes lenses and mirrors to achieve the anamorphism

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necessary to compress the width of the motion picture image while holding the height constant.

Another typical use of an anamorphic optical system is shown in the patent 2,798,411, issued July 9, 1957 to Kenneth Coleman. Here the inventor utilizes known optical components, such as prisms, located at right angles to each other to achieve his anamorphic optical system. A system such as this again is adaptable to be used with photographic equipment and wide screen projection and the like but due to the particular size and arrangement of the components is not easily adaptable to use on a microscope.

An anamorphic optical system designed for a microscope must of necessity be compact and require essentially no modification to the microscope in order to adapt it to use with the microscope. In addition, such an eyepiece system must be easily and quickly interchangeable with the standard eyepieces as used on the microscope. And, finally, such an anamorphic system should provide a continuously variable anamorphism in any desired direction with an erect image and no loss of field.

SUMMARY OF THE INVENTION

Accordingly, the anamorphic optical system of my invention comprises a pair of identical field and collimating lenses with the prism anamorphic components placed therebetween. An image inverting prism of the Pechan type is placed between the pair of collimating and field lens to fold the optical path and to erect the image. This is accomplished by locating the Pechan prisms 90° relative to each other in the optical system.

In keeping with this summary, it is an object of this invention to provide a continuously variable anamorphic eyepiece system designed for a microscope, said system being compact and providing a continuously variable anamorphism over the range of 1x to 2.2x.

Another object of this invention is to provide a continuously variable anamorphic eyepiece system wherein the image is inverted and reverted by means of a pair of optical prisms spaced 90° relative to each other.

Yet another object is to provide a new and novel anamorphic optical system designed for a microscope or the like whereby the continuously variable anamorphism is achieved by means of a plurality of pivotal prisms, said prism being pivotal mechanically simultaneously through predetermined angles thereby providing the desired degree of anamorphism, said prisms also being rotatable 360° about the optical axis of the system.

These and other objects and advantages of my invention will become apparent from the following description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a general perspective view of the anamorphic eyepeices of my invention mounted on a microscope;

Figure 2 shows the arrangement of the anamorphic optical system in its operative plane;

Figure 3 shows the prism components of the anamorphic system showing the constructional data of the prisms;

Figure 4 is a sectional view of the variable anamorphic eyepiece system showing the location of the various components, the mounting of the components and the means for pivoting the components.

Figure 5 is a sectional view of the pivot means taken along line 5-5 of Figure 4.

DESCRIPTION OF PREFERRED EMBODIMENT

The anamorphic eyepiece optical system comprising my invention is shown in Figure 1 of the drawings and comprises eighteen optical elements, hereinafter numbered L_1 through L_{18} respectively, said elements all being physically located within the eyepiece structure 10. The eyepiece structure 10 is mounted by means of a clamp ring 11 to a standard microscope 12, being interchangeable with the existing eyepiece mountings of the microscope 12.

The eyepiece structure 10 contains an azimuth control ring 13 for rotating the anamorphic direction of the optical system along with an azimuth lock ring 15 to lock the rotation of the optical components. Also included on the eyepiece structure 10 is a zoom control 17 for varying the magnification of the optical system within the design limits as will be hereinafter described.

Turning now to Figure 2, there is shown the arrangement of eighteen optical elements contained within the eyepiece structure 10. While the eighteen optical elements are shown in their operative plane in this figure, it should be noted at this time that the optical elements L_{16} and L_{17} are shown 90° out of their actual position for purposes of clarity in showing the critical angles necessary for constructional purposes. In actual practice, the elements L_{16} and L_{17} are positioned 90° around the optical path of the optical system relative to the optical elements L_2 and L_3.

The first optical element L_1 is a standard field lens as commonly utilized in optical systems and is fixedly mounted in front of an image inverting prism L_2,L_3. Immediately to the rear of the image inverting prism assembly L_2,L_3 is located the first collimating lens assembly L_4,L_5, also fixedly mounted in the optical system.

The next four optical assemblies of my system constitute the zoom prism assembly and consists of four pivotal anamorphic prisms, all being pivotly mounted in relationship to each other. Immediately after the anamorphic prisms, numbered respectively L_6-L_{13} in

Figure 2 is located the second collimating lens assembly L_{14}, L_{15}. This lens assembly is fixed in the optical system in a manner similar to the first collimating lens assembly L_4, L_5.

Located a fixed distance from the second collimating lens assembly L_{14}, L_{15} is a second image inverting prism assembly L_{16}, L_{17} fixedly mounted in the eyepiece structure 10. Completing the basic optical system is a second field lens L_{18} fixedly attached to the eyepiece structure 10 at a given distance from the second prism assembly L_{16} and L_{17}.

The constructional data for the lens elements of the basic optical system is given in the following Table I, wherein the letter S represents a distance from one lens element to another, the letter R represents a radius of the lens element, the letter t represents the thickness of the lens element with reference being made to the figures of the drawings for directions of curvature.

TABLE I

ELEMENT	DISTANCES IN MM	Index	ABBE V
L_1	S_1 = 1.0	1.517	64.5
	R_1 =		
	t_1 = 3.57		
	R_2 = 31.39		
	S_2 = 8.67		

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TABLE I (CONT.)

ELEMENT	DISTANCES IN MM	INDEX	ABBE V
	S_3 = 0.5		
	R_3 = 87.052		
L_4	R_4 = 21.601	1.617	36.6
	t_3 = 1.0		
L_5	t_4 = 2.3	1.617	54.9
	R_5 = 87.052		
	S_4 = 2.0		
	R_6 = 87.052		
	R_7 = 21.601		
L_{14}	t_5 = 2.3	1.617	54.9
	t_6 = 1.0		
L_{15}	R_8 = 87.052	1.617	36.6
	S_9 = 0.5		
	S_{10} = 2.705		
	t_8 = 3.57		
L_{18}	R_9 = 31.39	1.517	64.5
	R_{10} =		
	S_{11} = 2.6		

The constructional data for the zoom prisms L_6, L_7, L_8, L_9, L_{10}, L_{11}, and L_{12}, L_{13}, is given in the following Table II wherein the angles a through f represent the internal angles of the respective prisms as shown in Figure 3 of the drawings:

TABLE II

ELEMENT	ANGLE	INDEX	ABBE V
L_6	a = 83°54' b = 69°27' c = 26°39'	1.617	62.7
L_7	d = 90°0' e = 11°39' f = 78°21'	1.613	31.3
L_8	a = 90°0' b = 78°21' c = 11°39'	1.613	31.3
L_9	d = 26°39' e = 90°0' f = 63°21'	1.617	62.7
L_{10}	a = 90°0' b = 76°0' c = 14°0'	1.613	31.3
L_{11}	d - 61°0' e = 90°0' f = 29°0'	1.617	62.7

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TABLE II (CONT.)

ELEMENT	ANGLE	INDEX	ABBE V
L_{12}	a = 14°0' b = 90°0' c = 76°0'	1.613	31.3
L_{13}	d = 70°0' e = 75°0' f = 29°0'	1.617	62.7

The constructional data for the image inverting prisms L_2,L_3 and L_{16},L_{17}, is given in the following table wherein the angles a-h represent the internal angle of the respective prisms as shown in Figure 2 of the drawings:

TABLE III

ELEMENT	ANGLE	INDEX	ABBE V
L_2	a = 45°0' b = 112°30' c = 22°30' d = 90°0'	1.541	59.9
L_3	e = 66°22'30" f = 47°15' g = 66°22'30" h = 90°0'	1.541	59.9

TABLE III (cont.)

ELEMENT	ANGLE	INDEX	ABBE V
L_{17}	(e = 45°0') (f = 112°30') (g = 22°30') (h = 90° 0')	1.562	51.0
L_{16}	(a = 67°30') (b = 45°0') (c = 67°30') (d = 90°30')	1.562	51.0

Referring now to Figure 3 of the drawings, there is shown the zoom prisms of the optical system in their respective positions with the numerals 14, 16, 18 and 20 representing the respective pivot points of the prism assemblies L_6L_7, L_8L_9, $L_{10}L_{11}$, and $L_{12}L_{13}$. It will be observed from Figure 3 that the first prism assembly L_6L_7 has its pivot point on the optical axis of the eyepiece system whereas the second prism assembly L_8L_9 has its pivot point disposed the distance shown as numeral 22 in Figure 3. This distance 22 has been found from analysis to be substantially 1.74 units in respect to the other zoom prism assemblies in order to obtain the optimum system.

Similarly, the pivot point of the prism assembly L_{10},L_{11} is located in the same plane as that of the element L_8L_9 and disposed above the optical axis of the system the distance shown as numeral 24 in the Figure 3. From analysis, it has been found that this distance should be substantially 1.54 units in order to achieve the optical properties necessary for the proper functioning of the optical system. The pivot point of the prism assembly $L_{12}L_{13}$, it will be observed, is located in the same plane as the three other prism assemblies of the zoom system but is located the distance shown by the numeral 26 below the optical path of the system. This distance 26 has been found from analysis to be ideally in the neighborhood of 3.86 units.

The constructional data for the axial relationship of the zoom prisms is shown in Figure 2 by the distances S_4,S_5,S_6,S_7 and S_8 wherein the distance S_4 represents the horizontal distance from the face of the lens element L_5 to the pivot point of the prism assembly element L_6L_7 with S_5 representing the horizontal distance from the pivot point of the prism assembly element L_6L_7 to the pivot point of the prism assembly L_8L_9. This distance S_6 represents the horizontal distance from the prism assembly $L_{10}L_{11}$ to the pivot point of the prism assembly $L_{12}L_{13}$. The distance S_8 in Figure 2 represents the horizontal distance from the pivot point of the prism assembly $L_{12}L_{13}$ to the face of the lens element L_{14}. The proper relationship of the distances S_4,S_5,S_6,S_7 and S_8 to each other are respectively 2.0 units, 6.26 units, 3.50 units, 5.98 units and 4.74 units.

When the zoom prism assemblies are positioned for a magnification of 2.2x, the distance, shown as the numeral 52, from the face of the prism element L_6 to the pivot point 14 of the prism assembly L_6L_7 has been found to be ideally 1 unit.

It should be noted at this point that the distance relationship of the pivot points of the zoom prism assemblies to the optical axis of the system and to each other has been given in units since the actual distance for S_4,S_5,S_6,S_7,S_8, 22, 24 and 26 shown in Figs. 2 and 3 is determined by the particular installation. For example, in the microscope application described, the units would be in millimeters while a different application of my anamorphic system may dictate other units resulting in a similar anamorphic system as long as the ratio of the units, as to each other, remains constant.

Figure 3 also shows the respective angles Ø1 -Ø4 through which the zoom prism assemblies are simultaneously pivoted in order to achieve a magnification ranging from 1x to 2.2x. The constructional data for the variation in the angles Ø1 -Ø4 is given in the following Table IV wherein M represents the magnification, Ø1 -Ø4 representing respectively the rotation angle of prism assemblies L_6,L_7,L_8,L_9,L_{10},L_{11}, and L_{12}, L_{13} to achieve the magnification M, Ø1 and Ø4 being rotated clockwise and Ø2 and Ø3 being rotated counter-clockwise with a change in sign representing a rotation of the prism angle past the vertical or zero prism angle:

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TABLE IV

M	ϕ_1	ϕ_2	ϕ_3	ϕ_4
2.200	-16.75°	28.35°	16.75°	-28.35°
1.938	-13.75°	24.8 °	13.75°	-24.8 °
1.600	- 7.75°	18.0 °	7.75°	-18.0°
1.242	1.25°	8.75°	-1.25°	- 8.75°
1.000	13.25°	-3.25°	-13.25°	3.25°

Referring now to Figures 4 and 5 there are shown sectional views of the variable anamorphic eyepiece system of my invention illustrating the means whereby the compound prisms, L_6L_7, L_8 L_9, L_{10} L_{11}, and L_{12} L_{13}, may be pivotably rotated simultaneously about their individual pivot points. The prism assemblies are rigidly fastened by well known means to a U-shaped member (28), held by second U-shaped member 30. Rigidly fastened to the first U-shaped member 28 and through the second U-shaped member 30 is a pair of bearing shafts 32 journalled in the frame member 34. The frame member 34 is rigidly attached to the azmuth control ring 13 in such a manner that rotation of the azmuth control ring 13 in turn rotates the frame member 34 around the optical axis of the eyepiece system.

The pair of bearing shafts 32 act as the pivot points for the respective prisms and are located at an appropriate distance from the optical axis as heretofore disclosed. For example, the sectional view shown in Figure 5 illustrates the prism assembly $L_{10}L_{11}$. By referring to Figure 3, it can be seen that the pivot point 18 for this prism assembly is located the distance shown by the numeral 24 above the optical axis of the system. From this it can be seen, by returning to Figure 5 that the bearing shafts 32 which form the pivot points 18 are located the distance 24 above the optical axis of the system.

Minor adjustments in the relationship between the first U-shaped member 28 and the second U-shaped member 30 are made by means of the set screw 36, contained in the drilled and tapped hole in the lower portion of the second U-shaped member 30. After the first and second U-shaped members 28 and 30 are properly positioned in relationship to each other, the set screw 36 may be tightened, thereby causing the U-shaped members to be fixedly attached together and thus allowing them to rotate as a unit.

The second U-shaped member 30 also contains on its lower portion a ball member 38 which acts as a cam follower as hereinafter described. Surrounding the refracting compound prisms L_6L_7, L_8 L_9,$L_{10}L_{11}$ and L_{12} L_{13}) is a cylindrical sleeve member 40 which is rigidly fastened to the zoom control 17 by means of a screw 42 contained in a recessed hole 44 on the zoom control 17.

The cylindrical sleeve member 40 has formed thereon a plurality of cam slots 46 which acts in cooperation with the ball member 38 and serve as the means whereby the prism assemblies may be simultaneously pivoted upon rotation of the zoom control 17.

The cam slots 46 are formed on the cylindrical sleeve member 40 in a manner well known in the art to cause the prism assemblies to simultaneously pivot about their respective pivot points through the angles as shown in the heretofore described table IV.

From the above, it can be seen that the rotation of the zoom control 17 causes the cylindrical sleeve member 40 to rotate, which in turn causes the respective refractive compound prism assemblies to pivot by well known cam and linkage means. Also from the above, it can be seen that a rotation of the azmuth control ring (13) causes a rotation of the frame member 34 about the optical axis of the system. This latter rotation, in turn, causes the four prism assemblies to be rotated about the optical axis of the system thereby allowing the direction of the anamorphism to be changed.

It will be noted in Figure 4 that the exit beam of the first prism assembly, L_2L_3, deviates the optical axis of the system, from the horizontal, by the angle shown as numeral 48 in Figure 4. It has been found from analysis that this angle should be substantially 2 degrees, 15 minutes in order to allow for proper eyepiece adjustment to maintain proper inter-pupillary distance.

Completing the optical system, it will be noted that a mask 50 has been interposed between the prism L_{16} and L_{17}. This mask was inserted into the optical system at this point in order to prevent stray light, from within the prism assembly L_{16}, L_{17}, from having an adverse effect on the optical system.

From the foregoing, it will be seen that I have provided new and novel means for accomplishing all of the objects and advantages of the invention. Nevertheless, it is apparent that many changes in the details of discussion, arrangement of parts or steps in the process may be made without departing from the spirit and scope of the invention as expressed in the accompanying claims and the invention is not to be limited to the exact matters shown and described, as only the preferred embodiments have been given by way of illustration.

I claim:

1. An anamorphic optical system for modifying the cross-sectional configuration of a beam of light, said system comprising in combination,

(a) a housing structure,

(b) a first field lens, L_1, fixedly attached to said structure,

(c) a first prism assembly, L_2L_3, fixedly attached to said structure,

(d) a first collimating lens assembly, L_4L_5, fixedly attached to said structure,

(e) four pivotal refracting compound prisms L_6L_7, L_8L_9, $L_{10}L_{11}$, $L_{12}L_{13}$, pivotably attached to said structure,

(f) means, operatively constructed, whereby said compound prismsmay be simultaneously pivoted about their individual pivot points in a predetermined manner,

(g) a second collimating lens assembly $L_{14}L_{15}$, fixedly attached to said structure,

(h) a second prism assembly $L_{16}L_{17}$, fixedly attached to said structure and orientated substantially 90° radially about the optical axis of the system in relationship to the orientation of the first prism assembly L_2L_3,

(i) a second field lens L_{18} fixedly attached to said structure.

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2. The optical system as defined in claim 1 and further characterized by the apices of the two inner prisms L_8L_9 and $L_{10}L_{11}$ pointing in the same direction as one another with the apex of the prismatic air space therebetween pointing in the opposite direction.

3. The optical system as defined in claim 2 and further characterized by the apices of the two outer prisms L_6 L_7 and L_{12} L_{13} pointing in the same direction as the apex of the prismatic air space between the two inner prisms L_8L_9 and $L_{10}L_{11}$.

4. The optical system as defined in claim 3 and further characterized by the pivot points of the two outer prisms L_6L_7 and $L_{12}L_{13}$ being located substantially on the optical axis of the system and substantially 3.86 units therefrom respectively, with the pivot points of the two inner prisms L_8L_9 and $L_{10}L_{11}$ being located substantially 1.74 units and substantially 1.54 units respectively from the optical axis of the system.

5. The optical system as defined in claim 4 and further characterized by the pivot points of the refracting prisms L_8L_9,$L_{10}L_{11}$,$L_{12}L_{13}$ being located axially

along the optical axis of the optical system the distances, a distance from the refracting prism L_6L_7, substantially of 6.26 units, 3.50 units and 5.98 units respectively.

6. In a prism type anamorphic zoom optical system for modifying the cross-sectional configuration of a beam of light, said system being of the type comprising a pair of field lenses L_1 and L_{18}, a pair of prisms L_2L_3 and $L_{16}L_{17}$, a pair of collimating lens assemblies L_4L_5 and $L_{14}L_{15}$ and four refracting compound prisms L_6L_7, L_8L_9, $L_{10}L_{11}$, and $L_{12}L_{13}$, said compound prisms being pivotally rotated about their individual pivot points through the angle ϕ, the improvement comprising a continuously variable prism anamorphic zoom system of the constructional data set forth in the following table wherein M represents the magnification, ϕ_1 through ϕ_4 represents respectively the rotation angle of prisms L_6L_7, L_8L_9, $L_{10}L_{11}$, and L_{12} L_{13} to achieve the magnification M, ϕ_1 and ϕ_4 being rotated clockwise and ϕ_2 and ϕ_3 being rotated counterclockwise with a change in sign representing a rotation of the prism angle ϕ past the vertical or zero prism angle:

M	ϕ_1	ϕ_2	ϕ_3	ϕ_4
2.2	-16.75°	28.35°	16.75°	-28.35°
1.938	-13.75	24.8	13.75	-24.8
1.6	- 7.75	18.0	7.75	-18.0
1.242	1.25	8.75	-1.25	- 8.75
1.0	13.25	-3.25	-13.25	3.25

Sole

Oath, Power Of Attorney, And Petition

25X1

Being duly sworn, I, [redacted]

depose and say that I am a citizen of The United States of America residing at

25X1

[redacted] ; that I have

read the foregoing specification and claims and I verily believe I am the original, first, and sole

inventor of the invention or discovery in

PRISM VARIABLE ANAMORPHIC OPTICAL SYSTEM

described and claimed therein; that I do not know and do not believe that this invention was ever known or used before my invention or discovery thereof, or patented or described in any printed publication in any country before my invention or discovery thereof, or more than one year prior to this application, or in public use or on sale in the United States for more than one year prior to this application; that this invention or discovery has not been patented in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than twelve months before this application; and that no application for patent on this invention or discovery has been filed by me or my representative or assigns in any country foreign to the United States, except as follows:

25X1

And I hereby appoint [redacted] Registration No. 16,692

~~and~~ -------- ~~Registration~~ No. -------- whose address is care

25X1

[redacted] my attorney with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith.

Wherefore I pray that Letters Patent be granted to me for the invention or discovery described and claimed in the foregoing specification and claims, and I hereby subscribe my name to the foregoing specification and claims, oath, power of attorney, and this petition, this

21st day of September, 1967.

Inventor [redacted] 25X1

Post Offi[redacted]

State of NEW YORK

County of MONROE

SS

Before me personally appeared [redacted] 25X1

to me known to be the person described in the above application for patent, who signed the foregoing instrument in my presence, and made oath before me to the allegations set forth therein as being under oath, on the day and year aforesaid.

MBR

NOTARY PUBLIC

SEAL

This form may be executed only when attached to a complete application as the last page thereof.

ASSIGNMENT BEFORE PATENT

In consideration of the sum of One Dollar and other good and valuable considerations to me in hand paid by [redacted] 25X1

25X1 [redacted] having its principal place

25X1 of business [redacted] the receipt of which is hereby acknowledged, I do hereby sell and assign to said Corporation, its successors and assigns, the entire right, title and interest, including all right to acquire foreign patents, in and to my inventions in

PRISM VARIABLE ANAMORPHIC OPTICAL SYSTEM

described and set forth in an application executed by me this 21st day of September, 19 67 and about to be filed at the Patent Office for the purpose of obtaining Letters Patent of the United States therefor; and I do hereby authorize and request the Commissioner of Patents to issue the Letters Patent that may be granted for said inventions in accordance with this assignment.

IN WITNESS whereof I have hereunto set my hand this 21st day of September, 19 67 25X1

[redacted]

COUNTY OF MONROE : ss.
STATE OF NEW YORK

On this 21st day of September, 19 67 personally appeared before me, a Notary Public in and for Monroe County,

25X1 [redacted]

to me known, and known to me to be the person described in and who executed the above instrument, and he acknowledged to me that he executed the same.

MBR
Notary Public.

SECRET
(When Filled In)

SPEED LETTER	REPLY REQUESTED ✓ YES / NO	DATE 10-26-67 / LETTER NO.

TO : NPIC/PDS
ATTN: [redacted]

FROM: CSS/PD/DL

25X1 [redacted]

Attached is copy of patent application filed by Contractor on 9-25-67 on Prism Variable Anamorphic Optical System developed under this contract.
Will you let us know whether the subject matter, as distinguished from Agency interest, is classified.

[redacted] 25X1

SIGNATURE

REPLY	DATE 8 November 1967

This speed letter is being returned for attachment of the patent application which was never received. Please check to confirm that the proper Contract Number is associated with application. Contract [redacted] 25X1 Zoom 70 Dovetail Rhomboid Retrofit. The Variable Precision Anamorphic Optical System was developed under Contract [redacted] 25X1

[redacted] 25X1

SIGNATURE

RESPONDER'S FILE

FORM 5-61 1831

SECRET

27 APR

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PER PAIR

15 - 5500 ea
50 - 3000 ea
1000 - 1500 ea

BUDGET ESTIMATES ON ANAMORPHIC EYEPIECES